World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:13, No:03, 2019

Application of Deep Learning Algorithms in Agriculture: Early Detection of Crop Diseases

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Abstract : Farming community in India, as well as other parts of the world, is one of the highly stressed communities due to reasons such as increasing input costs (cost of seeds, fertilizers, pesticide), droughts, reduced revenue leading to farmer suicides. Lack of integrated farm advisory system in India adds to the farmers problems. Farmers need right information during the early stages of crop's lifecycle to prevent damage and loss in revenue. In this paper, we use deep learning techniques to develop an early warning system for detection of crop diseases using images taken by farmers using their smart phone. The research work leads to building a smart assistant using analytics and big data which could help the farmers with early diagnosis of the crop diseases and corrective actions. The classical approach for crop disease management has been to identify diseases at crop level. Recently, ImageNet Classification using the convolutional neural network (CNN) has been successfully used to identify diseases at individual plant level. Our model uses convolution filters, max pooling, dense layers and dropouts (to avoid overfitting). The models are built for binary classification (healthy or not healthy) and multi class classification (identifying which disease). Transfer learning is used to modify the weights of parameters learnt through ImageNet dataset and apply them on crop diseases, which reduces number of epochs to learn. One shot learning is used to learn from very few images, while data augmentation techniques are used to improve accuracy with images taken from farms by using techniques such as rotation, zoom, shift and blurred images. Models built using combination of these techniques are more robust for deploying in the real world. Our model is validated using tomato crop. In India, tomato is affected by 10 different diseases. Our model achieves an accuracy of more than 95% in correctly classifying the diseases. The main contribution of our research is to create a personal assistant for farmers for managing plant disease, although the model was validated using tomato crop, it can be easily extended to other crops. The advancement of technology in computing and availability of large data has made possible the success of deep learning applications in computer vision, natural language processing, image recognition, etc. With these robust models and huge smartphone penetration, feasibility of implementation of these models is high resulting in timely advise to the farmers and thus increasing the farmers' income and reducing the input costs.

Keywords : analytics in agriculture, CNN, crop disease detection, data augmentation, image recognition, one shot learning, transfer learning
Conference Title : ICBDAIC 2019 : International Conference on Big Data Analytics and Intelligent Computing
Conference Location : Tokyo, Japan
Conference Dates : March 25-26, 2019